Environmental Health Risks

Definition: A risk in the natural or human-made environment that increases the chances that humans will experience some adverse effect on their health, including illness, injury, premature death, or disability.

Summary

Our environment contains many risks. These risks can come from numerous sources including: contaminated outdoor and indoor air; contaminated water supplies; contaminated foods; the physical environment, such as improper playground equipment; diseases transmitted to man by animals and insects, such as rabies, hantavirus, or Lyme disease; radiation; and hazardous substances, such as pesticides.

The effect of these risks on the population is very difficult to measure. Some conditions may become apparent in a matter of minutes and be self-limiting. Others may take 30 years or more to develop and can be fatal.

Direct measurement of human health effects is sometimes possible using data from sources such as the state's hospital discharge data system, the state cancer registry, or other sources. In areas where health outcome measures are not available, environmental measures can be used to estimate the human health impact. Improved outcome measures are currently being developed by state and local health departments that will allow a more accurate measure of environmental risks. With this information, health departments can better target their risk reduction efforts.

Exposure to environmental risks may be reduced by decreasing and preventing environmental contaminants, separating the risk source from the population, providing health education on how to avoid or minimize the risk, and changing behavior.

Introduction

To live on this earth is to experience environmental risk. The level of an individual's specific environmental risk is determined by behavior, genetics, current health conditions, and the degree of exposure to the existing environmental conditions at home, work, and play.

This report focuses on seven major areas of risk:

- Air Quality
- Water Quality
- Food Safety
- Physical Hazards
- Vectorborne and Zoonotic Diseases
- Radiation
- Hazardous Substances

Outdoor Air Quality

Risk Factors. Air pollution is related to a range of respiratory diseases including chronic bronchitis, pulmonary emphysema, lung cancer, chronic and acute respiratory disease, heart disease, nervous system damage, immune effects, bronchial asthma, and reproductive and developmental effects. The nation's annual health costs from exposure to the most serious air pollutants are estimated to range from $40 to $50 billion.[1] Health impacts from air pollution are disproportionately felt by vulnerable populations such as children, the elderly, the immuno-compromised, and persons with existing respiratory illnesses. The primary sources of air pollution in Washington today are: motor vehicles (55%), industry (21%), outdoor burning (12%), and wood stoves and fireplaces (12%).

Indicators. Links between toxic air pollutions and health effects are not well documented, with the exception of the six "criteria pollutants" (see next page). The best source of information on the subject in Washington is data on hospitalization for severe respiratory and cardiac conditions.

It would be helpful to establish a surveillance system for air pollution-related health conditions to help answer questions about prevalence and health impact of air pollution and a statewide community complaint database to record and track complaints.

The Department of Ecology and seven local air pollution control authorities currently receive most of the air quality complaints within their regions. This information would be useful for identifying and prioritizing areas within the state which are potentially in need of health analysis or data collection.

Interventions. The Clean Air Act of 1970 and the Clean Air Act Amendments of 1990 address six national "criteria pollutants" and 189 other "toxic air pollutants". The criteria pollutants--ozone, particulate matter (PM-10), carbon monoxide, sulfur dioxide, nitrogen dioxide, and lead--are considered ubiquitous and thereby capable of being regulated by a nationally applicable standard. The toxic air pollutants identified are attributed to local sources which must be individually addressed by states and local air authorities. The Department of Ecology adopted rules in 1991 to control air pollution from more than 500 toxic or cancer-causing chemicals and along with local air pollution control authorities across the state conducts monitoring for some of the criteria pollutants, issues permits for new and modified sources of air pollution, and carries out other provisions of the federal and state air pollution laws.

During the 1970s and 1980s, air pollution from industry was reduced by over 90 percent through increased awareness, regulation, and control of technology advances. Air quality for criteria pollutants has been improving in much of the state. Continued improvements will come through extension of regulations and strategies; enhanced technical assistance and standards development for regulatory agencies; and increased public education and awareness of the effects on air quality of individual actions and lifestyle choices.

Indoor Air Quality

Risk Factors. Indoor air pollution is related to a wide range of health effects, both acute and chronic. Exposure to pollutants may cause immediate effects such as irritation of the eyes, nose and throat, headaches, dizziness, and fatigue or long term effects such as respiratory disease, heart disease, and cancer. Several recent studies by the National Academy of Sciences and the Environmental Protection Agency have identified indoor air pollution as one of the most important environmental risks to the nation's health.[2] Studies have found that concentrations of certain volatile organic compounds can be 10, 100, and in some cases 1000 times higher indoors than they are outdoors.[3] The trend of increasing exposure to indoor air pollutants is partly attributable to construction of well-sealed homes and offices, off-gassing of chemicals from synthetic building materials and fabrics, and the use of chemically based personal care and cleaning products. Indoor air pollutants of special public health interest include, but are not limited to, environmental tobacco smoke; formaldehyde and other volatile organic compounds; asbestos, carbon monoxide, nitrogen dioxide, and other combustion products; and numerous biological and other types of contaminants.

Indicators. Currently there is no surveillance system for health conditions related to indoor air pollution. The Washington State Department of Labor and Industries has estimated that approximately 20% of all on-site consultations requested by employers during the late 1980s and early 1990s were related to indoor air quality problems. The Department of Health and several local health agencies currently use phone tracking systems to record air quality complaints. This information, although relatively new, is generally used only to identify technical training and public information needs.

Interventions. Interventions vary depending on the nature of the indoor air quality problem and the health effects involved. Technical training for local health agencies regarding recognition, mitigation, and intervention strategies related to indoor air quality problems is available. Education and outreach to affected people, homeowners, school and building managers, maintenance personnel, builders, realtors and others is ongoing.

Water Quality

Risk Factors. Agents of concern that can be transmitted through water include bacteria, viruses, protozoa, and chemicals. These agents can cause illness when ingested in drinking water, in food prepared with water, in shellfish grown in water, or accidentally during water recreation. The sources of these agents include industrial discharges, agriculture, municipal sewer systems, solid waste

disposal sites, on-site wastewater disposal systems, and non point runoff.

Major waterborne epidemics of the past century have been substantially controlled by sanitary wastewater disposal and by disinfecting drinking water. Outbreaks may occur, however, where protection factors fail. In 1994, failing on-site wastewater disposal systems caused an outbreak of 48 cases of viral gastroenteritis by contaminating shellfish growing areas in Samish Bay of Skagit County.[4] That year in Walla Walla, 131 people reported becoming ill from well water contaminated with *Cryptosporidium.*[5]

Many other disease agents not endemic in this country are brought in by travelers. In 1994, twelve cases of typhoid fever acquired during travel to other countries were reported in Washington.[6] Without measures in place to protect drinking water from fecal pollution, imported cases of disease might lead to epidemics.

Indicators. Many of the infectious agents that can be transmitted through water can also be transmitted through food or directly from person to person. It is usually difficult, or impossible, to identify the mode of exposure that produces illness unless there is a large outbreak with a common identifiable source. Non-infectious agents at high exposure levels can produce acute illness, but chemical contaminants are rarely found in high enough concentrations in water, or foods contaminated by water, to cause acute illness. Due to difficulties in determining epidemiological relationships, most cases of waterborne illness cannot be identified or confirmed.

Interventions. Once the quality of water is degraded, it becomes difficult to correct. Ground water aquifers, particularly those that have been contaminated with chemicals, are usually lost to drinking water use.

The protection of water sources requires an approach to manage whole watersheds by integrated activities of industry, agriculture, the general public, and all levels of government. Protection measures focused on prevention of water source contamination include design standards for on-site wastewater disposal systems, manure management standards for dairy farmers, pretreatment standards for industrial plant discharges, and watershed/wellhead protection programs for drinking water supplies. Education is a major tool in helping people protect watersheds by encouraging such activities as maintaining on-site waste water systems, recycling motor oil, and reducing the use of pesticides.

Other protection measures that assure water is properly treated and safely distributed include: certification requirements for treatment plant operators; standards for waterworks design; control of cross-connections; surveillance for potential contamination; and the effective operation and management of public water systems.

Food Safety

Risk Factors. Foodborne illness can be especially harmful to certain segments of the population. High risk groups include young children, elderly people, and those who are immuno-compromised. Specific risk factors include poor food handling practices such as improper temperature control, poor personal hygiene, and cross-contamination. Additional risk factors for foodborne illness include: fresh and marine water contamination; the presence of naturally occurring phytoplankton biotoxins which affect shellfish; and bacteria, viruses, parasites, chemicals or toxins which may be present in our food supply.

Indicators. The primary indicators of a problem are symptoms of a disease, illness, or injury associated with consumption of a specific food. These symptoms may include: liver damage, neurologic injury, circulatory difficulties, breathing difficulties, nausea, vomiting, diarrhea, fetal abnormalities, gastroenteritis, and septicemia.

It is widely believed that the number of foodborne illnesses that are reported each year represent only a small percentage of the actual foodborne illnesses that occur. In Washington state, reported foodborne illness outbreaks remained fairly constant from 1981 to 1992, ranging from 31 to 62 outbreaks annually. During 1993 and 1994, there was a marked increase in reported outbreaks of foodborne illness. The number of reports more than doubled in 1993 to 130, and tripled in 1994 to 151. This trend appears to have continued in 1995. The increase is probably not indicative of more cases of disease, but more likely an increased awareness among the public and health care providers of the need to report possible foodborne illness cases and

outbreaks to local health agencies for investigation.

Interventions. The principle methods of preventing and controlling foodborne illness are: education of the public, food handlers, and food managers about food safety; surveillance and epidemiological investigation of foodborne diseases; development and enforcement of food safety regulations; communication between all food safety agencies to avoid gaps or overlaps and to foster cooperation on food safety issues; and emergency response to food safety emergencies caused by floods, power outages, food product recalls, and tampering incidents.

Measurement of the effectiveness of some of these strategies has not been completed. However, there are reports on the effectiveness of management certification and inspection programs.[7] During the 1993 *E. coli* 0157:H7 outbreak in the Northwest, rapid public health action by local and state agencies resulted in the removal of 250,000 potentially contaminated hamburgers, preventing an estimated 800 cases of disease and four deaths.[8]

Physical Hazards

Risk Factors. In addition to the various microbial, radioactive, and chemical hazards in the environment today, physical hazards in home, work, and play environments expose a substantial portion of the population to increased risk. These exposures have results ranging from mere annoyance to death. Included in this discussion are injuries due to falls, drowning, suffocation, burns, and electrocutions. Many of the injuries associated with high risk occupations can be measured and prevented through actions taken to minimize harm such as hearing protection for workers in high noise industries. Injuries in the home and at play are less well documented and far more difficult to prevent.

Indicators. According to the Washington State Vital Statistics Report, produced by the Department of Health, Center for Health Statistics, unintentional injuries were the fifth leading cause of death in Washington State in both 1992 and 1993. The highest risk age group is 15-19 year olds. Motor vehicle related deaths are the leading cause of unintentional injury death in Washington, followed by falls, poisoning, and drowning. Almost half of all unintentional injury deaths are due to injuries in the home--far greater than the combined unintentional injury deaths in nursing homes, agriculture, and industry (11%).

The leading causes of hospitalizations for nonfatal injury in Washington State in 1994 were falls at 296.2/100,000, followed by motor vehicle (occupant) at 59.8/100,000, non-medical poisonings at 23.6/100,000, and overexertion at 24.7/100,000.

Interventions. Interventions vary, depending on the nature of the incident, affected population, and degree of intrusion needed. Education is warranted in all situations. Falls can be prevented in some instances by better design. Design must be targeted through building standards where supervision cannot be required (such as in homes). Deaths from poisoning can be partially controlled with appropriate labeling and unpalatable taste additives, but injury prevention continues to rely on education, proper storage, and access to proper medical care. Drowning and near drowning is best prevented by proper supervision (especially with young children), physical barriers, use of personal flotation devices, and teaching swimming skills and cardio-pulmonary resuscitation (CPR).

Vectorborne and Zoonotic Diseases

Risk Factors. In *vectorborne* disease, infectious agents (bacteria, virus, protozoan) are transmitted to humans via arthropods (ticks, mosquitoes, fleas) which are required for disease transmission. Examples are plague, viral encephalitis, Lyme disease, relapsing fever, tularemia, and Rocky Mountain spotted fever. In *zoonotic* disease, infectious disease agents are transmitted from animals (pets, livestock, wild animals, birds, reptiles) to humans. Examples are rabies, hantavirus, salmonellosis, and psittacosis.

Persons exposed to vectors (ticks, mosquitoes, fleas) and animals known to carry infectious diseases are at increased risk of contracting vectorborne or zoonotic disease. Exposure can occur in the household, at work, and during recreational activities. Examples of persons with higher exposure risk are:

- bird owners (psittacosis)
- rural residents with rodent infestations (hantavirus)
- reptile owners (salmonellosis)
- trappers (plague, tularemia)
- veterinarians (rabies, Q fever, brucellosis)

• campers and hikers (diseases transmitted by ticks)

• persons who handle, care for, or feed wildlife (rabies)

Indicators. Tracking and control of vectorborne and zoonotic diseases is done through surveillance and investigation of reportable cases. Since 1990, several rare or newly recognized vectorborne or zoonotic diseases have occurred in Washington state.

In 1995, the first human rabies fatality since 1939 occurred in Lewis County as a result of exposure to a rabid bat. Bats are the only known reservoir for rabies in Washington. Elsewhere in the United States rabies occurs in raccoons, foxes, skunks, coyotes, and bats. There have been several incidents in which rabid wild animals have been illegally moved from one state to another resulting in the importation of the rabies virus, and possibly creating a new reservoir.

In 1993, hantavirus was recognized as causing an outbreak of a serious respiratory illness in the southwest United States. Since 1993, there have been nine human Hantavirus cases in Washington, six of which were fatal, and Hantavirus-positive rodents have been found in the state.

An increasing number of human salmonellosis cases linked to pet reptile exposure have occurred since 1991. Young children are particularly susceptible. In addition to reptiles, other exotic species including hedgehogs, prairie dogs, flying squirrels, and primates are being kept as pets. The risk of disease transmission or injury to humans from exotic pets is generally unknown, but a human salmonellosis case has been linked to a pet hedgehog in Washington.

In the fall of 1995, an outbreak of psittacosis was identified at a large national chain pet store in Washington. Five employees and several birds were confirmed with psittacosis.

In the past, human plague and mosquito-borne viral encephalitis cases have occurred in this state. Testing in the 1980s revealed the presence of plague in a variety of wild mammals in eastern and western Washington. While human plague has not been reported since 1984 and mosquito-borne encephalitis not since 1988, the threat remains.

The first locally acquired cases of babesiosis, a tickborne disease, occurred in Klickitat County in 1991, and erlichiosis, another tickborne disease, has also recently occurred. Several other tick-borne diseases are reportable in this state and up to a dozen cases each of Lyme disease or relapsing fever are reported each year. About one case a year of tick paralysis also occurs.

Interventions. Intervention consists of reducing human exposure to vectorborne and zoonotic diseases. Strategies include: change voluntary behaviors through education aimed at reducing exposures by avoiding contact with wildlife; encourage effective rodent control measures in the home, workplace and in recreational settings; promote rabies vaccination for all pet animals; provide, maintain, and interpret surveillance (disease testing) data for vectors (arthropods) and reservoir (animal) populations in the state; offer technical assistance for vector control to reduce and control vector populations; educate pet store owners and pet owners about the risks of disease transmission from pets, especially for special populations such as immuno-suppressed individuals; control disease transmission following a human or animal case; update regulations regarding importation of exotic pets; and protect high risk individuals through immunization (rabies).

Radiation

Risk Factors. Washington's citizens are inevitably exposed to ionizing and non-ionizing radiation. The sources may be natural or of human origin.

Natural sources include radiation from space (both ionizing and non-ionizing), radiation from natural radioactive sources in the ground, radiation from radionuclides naturally present in the body, and inhaled and ingested radionuclides of natural origin such as radon. Increased exposure to natural sources may result from activities such as high altitude air travel and mining.

A variety of exposures result from human-made materials and devices such as radiopharmaceuticals and x-ray machines in medicine, and consumer products containing radioactive materials such as some smoke detectors. Exposures may also occur from episodic events such as atmospheric nuclear weapons testing and accidents such as at Chernobyl. Past releases from operations on the Hanford Nuclear Reservation have also resulted in exposure to some of the regions population. Non-ionizing exposures may result from electrical transmission lines and radio frequency towers.

For most of the exposure conditions described above, radiation is received at low dose rates either continuously, as with natural radiation or atmospheric fallout, or in random small increments, as in occupational or medical exposures. While the state's entire population is impacted by radiation exposure, groups at higher risk for adverse health effects include children and pregnant women.

Indicators. Of the various types of biomedical effects or indicators that may result from irradiation at low doses and low dose rates, alterations of genes and chromosomes are the best documented. Recent studies have extended our knowledge of the dose-response relationships and have resulted in more restrictive regulations in some cases.

Medical x-rays and radon contribute the majority of the ionizing radiation dose for state residents. The most complete data are from a residential radon survey done in 1991/92. It showed that approximately 100,000 state residents are at risk from residential radon levels. Currently there are no regulations in place to control non-ionizing radiation sources.

Interventions. The goal of radiation protection is to prevent the occurrence of radiation induced conditions in exposed persons by applying dose limits that are below levels of known health impact. An active regulatory program insures that this goal is achieved. Other methods of preventing overexposure to radiation include public education, environmental surveillance, and emergency planning.

Pesticides

Risk factors. Pesticides are used widely by agricultural workers, homeowners, professional exterminators and landscapers, and maintenance staff for buildings and grounds. Wherever they are used there is significant potential for accidental spills and splashes, and for health problems resulting from improper storage and use.

Approximately half of reported pesticide related illnesses in Washington are associated with agricultural pesticide use. The remaining cases are associated with a variety of uses. Agricultural incidents generally occur due to improper reading of labels and not using or improperly using personal protective equipment.

For persons living near farms or treated landscapes, pesticide drift continues to be a frequent problem in Washington. Although most human health symptoms which result from drift are short lived and resolve with little or no treatment, data suggest that drift can exacerbate symptoms in people with preexisting health problems such as asthma. Finally, children under 3 years of age are at risk for pesticide ingestion when pesticides are improperly stored in the home. More than 25% of reported pesticide poisonings in 1994 involved pesticide ingestion by young children. The majority of these cases were rodenticide ingestion and resulted in no symptoms, but ingestion of other pesticides have had serious results.

Indicators. The Department of Health (DOH) has monitored incidence of pesticide related illness in Washington since 1990. Data collected largely address acute rather than chronic exposures and do not monitor for chronic health effects of low level pesticide exposure. DOH monitoring is coordinated with data collected by other state agencies through the Pesticide Incident Reporting and Tracking (PIRT) Review Panel. Data from four agencies, along with analysis and recommendations, are published annually in the PIRT report. These data allow monitoring of the incidence of pesticide drift, agricultural exposure, childhood exposure, and other exposures of concern.

The DOH data show a decrease in reported incidents from 1993 to 1994. The population still at highest risk for pesticide related illness in 1994 was pesticide mixers, loaders, and applications working in fruit trees. Overall, reports of agricultural complaints decreased and resident (non-commercial) complaints have increased.

Interventions. Interventions have been targeted at high risk groups identified by surveillance data. Strategies include: development of a fotonovella (in Spanish) targeting Hispanic pesticide handlers in the fruit industry; presentations to farmworkers on the proper use of pesticides and safety equipment; educational outreach to professional pesticide applicators who work primarily in the residential setting; and short courses and in-service training for health care providers on how to recognize and treat pesticide poisoning. The PIRT Panel is currently evaluating residential incidents to identify common problems and develop preventative strategies.

Hazardous Waste Sites

Risk Factors. Hazardous waste generation, treatment, disposal, and storage may put the public health at risk. The potential risk to human health posed by hazardous waste sites is based on such factors as the toxicity of the contaminant, the concentration of the contaminant in the environmental media (air, water, soil), the length and level of exposure to the contaminant, and individual susceptibility such as genetic factors and being immuno-compromised.

Common contaminants at hazardous waste sites include toxic substances such as heavy metals, volatile organic compounds, radioactive waste, and arsenic. The potential health effects include: tumors; cancers; and kidney, brain, neurological, bone and liver damage.

Indicators. The health effects that may be caused from exposure to hazardous waste vary greatly as listed above. Since each of these outcomes can also be caused by factors other than exposure to hazardous waste, separating out the various causes in any surveillance activity is extremely difficult or impossible. Studies done in communities near hazardous waste sites are also difficult due to the relatively small number of people potentially exposed, and the uncertainty in the exposure. The potential for exposure does exist however, and the Department of Health approaches this problem through a public health assessment process for communities living near hazardous waste sites.

In Washington state there are currently 61 sites which are on the National Priorities List (Superfund sites). Of these, the Hanford Nuclear Reservation is the largest and most costly to remediate. The site encompasses 560 square miles in southeastern Washington. There are 624 sites (excluding the Superfund sites) throughout the state that are part of a state hazardous waste cleanup program similar to the Superfund program. The state sites are in various stages of investigation and clean up. Over half of the sites are located in the Puget Sound Basin. They range from large municipal landfills to underground storage tanks.

Intervention. Under the state Model Toxic Control Act (MTCA), with the Department of Ecology as the lead agency, the Department of Health implements public health-related activities at state hazardous waste sites. Working with the Environmental Protection Agency and the Agency for Toxic Substances and Disease Registry, the Department of Health implements public health-related activities at Superfund sites. These activities include public health assessments, health consultations, and health studies. The department also provides health information and education for communities located near hazardous waste sites, and for health care providers working in those communities. In addition to the health education, the department also provides technical resources to health providers, offers on-line database searches, and provides toxicological information when requested.

Data Sources.

Environmental Health Resource Directory, June 1995.

MTCA 1995 Annual Report.

Pesticide Incident Reporting and Tracking Review Panel Annual Report 1990-1994.

End Notes

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[5] Department of Health, Annual Communicable Disease Report, 1994, October, 1995.

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